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# Summary of Knowledge of White-Sided Dolphins (*Lagenorhynchus acutus*) from US and Canadian Atlantic Waters

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ABSTRACT

White-sided dolphins are found in temperate and sub-polar waters of the US and Canadian North Atlantic, from central west Greenland, south to North Carolina (35°N) and perhaps as far east as 43°W. No genetic information is available to define the population structure, but distributions of sightings, strandings and incidental takes suggest that three population units may exist: Gulf of Maine, Gulf of St Lawrence and Labrador Sea. The most recent abundance estimate, 27,200 (CV = 43%), is from a line-transect survey conducted during summer in waters from Virginia to the Gulf of Maine, lower Bay of Fundy and eastern Scotian slope region. White-sided dolphins have been caught in otter trawls and sink gillnets off the northeast coast of New England, in offshore US pelagic drift gillnets and mackerel off-bottom trawls, in groundfish sink gillnets from the Bay of Fundy, Newfoundland and Labrador Seas and in salmon gillnets from the Labrador Sea. For 1990-1995, the estimated average annual bycatch in US fisheries was 181 animals (CV = 25%). No estimates are available on bycatch in Canadian fisheries. Little information exists on the life history and feeding ecology of this species in the northwest Atlantic. PCBs, DDT and heavy metals have been found in the blubber of white-sided dolphins; however, it is unclear how to interpret these data.

KEYWORDS: WHITE-SIDED DOLPHINS; NORTH ATLANTIC; DISTRIBUTION; STRANDINGS; SURVEY; ABUNDANCE; INCIDENTAL CAPTURE; POLLUTION; REVIEW

## DISTRIBUTION, SEASONAL AND SPATIAL

White-sided dolphins (*Lagenorhynchus acutus*) are found in temperate and sub-polar waters of the US and Canadian North Atlantic, from central west Greenland, south to North Carolina (35°N) and perhaps as far east as 43°W (Evans, 1987). These animals inhabit continental shelf waters and are most abundant in areas of steep topographic relief (Gaskin, 1992).

In US waters, white-sided dolphins are most common over the continental shelf from Hudson Canyon (approximately 39°N) north to the Gulf of Maine. Sighting (Fig. 1) and stranding data (Table 1) indicate seasonal shifts in distribution. From June to September, large numbers of white-sided dolphins inhabit waters from Georges Bank to the lower Bay of Fundy (Payne and Heinemann, 1990), and strandings occur from New Brunswick, Canada to New York (Smithsonian stranding database 1996). From October to December, strandings have been reported only in Massachusetts and New York, and sightings occur at intermediate densities from the southern Gulf of Maine to southern Georges Bank. From January to May, fewer dolphins are found in the southern Gulf of Maine and Georges Bank area and a few strandings have been collected on beaches of Virginia and North Carolina. Sightings south of Georges Bank, around Hudson Canyon, occur at all times of the year but at very low densities. This has been documented between 1980 and 1988 by marine mammal observers on NOAA fishery surveys (Fig. 1), between 1978 and 1982 on dedicated marine mammal aerial surveys (CeTAP, 1982), and in April 1993 from a marine mammal aerial survey where white-sided dolphins were seen near Hudson Canyon (39.5°N, 72.2°W; NMFS unpubl. data). Incidental takes (NMFS unpubl. data) of white-sided dolphins have also been recorded in this southern area during winter and spring. These observations appear to represent the southern extent of the species range in the western North Atlantic.

Prior to the 1970s, white-sided dolphins in US waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species (Katona *et al.*, 1993; Kenney *et al.*, 1996). The increase in numbers of white-sided dolphins seen on the continental shelf may have been a result of changes in the abundance and distribution of prey species, such as sand lance (*Ammodytes dubius*) and herring (*Clupea harengus*), which may have been related to large-scale water temperature changes.

During summer and fall, the density of white-sided dolphins is lower around the southern tip of Nova Scotia than in the southern Gulf of Maine and Georges Bank region (Gaskin, 1992; Blaylock *et al.*, 1995). Sightings of this species are infrequent along the Atlantic coast of Nova Scotia (Gaskin, 1992). This hiatus in distribution separates white-sided dolphins in the Gulf of Maine from those in the Gulf of St Lawrence. White-sided dolphins have been reported during the summer in the Gulf of St Lawrence as far west as the mouth of the Saguenay River. This species has also been seen in waters near Sable Island, in the Gully and in the Labrador Sea to western Greenland, extending to perhaps 71°N. The most easterly record from the western North Atlantic is from the Flemish Cap at 52°30'N, 43°31'W (Gaskin, 1992). Stenson and Reddin (1994) noted that, during spring, white-sided dolphins were caught using driftnets in an experimental salmon tagging program in the Newfoundland Basin and on the shelf waters of the Labrador Sea, but not on the Grand Banks, or off West Greenland.

## POPULATION STRUCTURE

Distributions of sightings, strandings and incidental takes suggest the existence of three population units: Gulf of Maine, Gulf of St Lawrence and the Labrador Sea.

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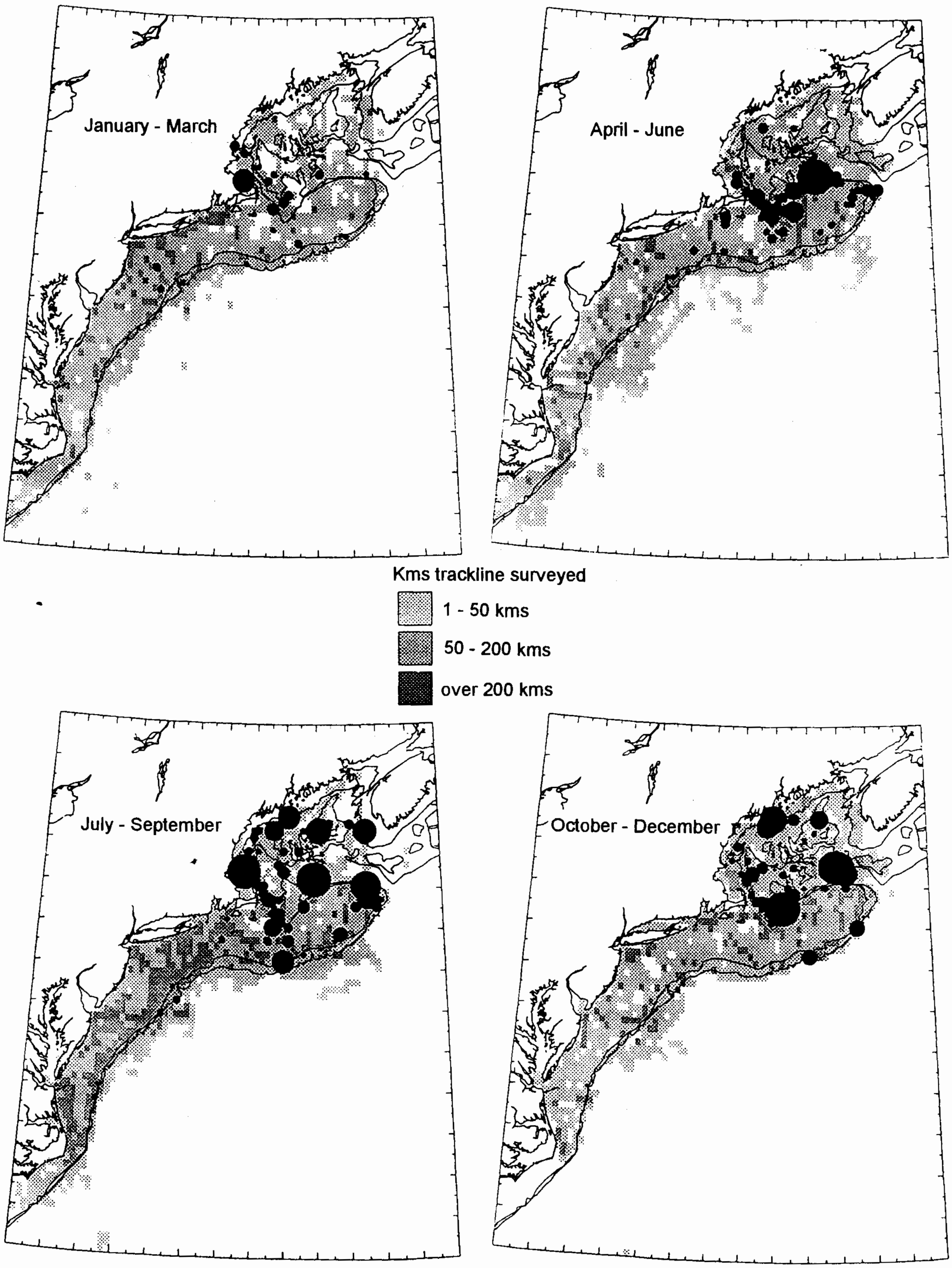


Fig. 1. Distribution of white-sided dolphins from sightings made from 1980 to 1988 from NOAA ships during fishery surveys collected by Manomet Bird Observatory. Dots represent location of sightings. Size of dot is proportional to the encounter rate of sightings seen in that grid cell. The larger the dot, the higher the encounter rate. Shading of grid cells indicates amount of effort (kms of trackline) spent searching for marine mammals in that grid cell. The darker the cell, the more the effort. If the cell is white, there was no search effort in that grid cell. Each map covers a quarter of the year. Contour lines indicate the 50 and 100 fathom (91 and 183m) depth contours.

Table 1

Number of white-sided dolphins stranded between 1970 and 1995, as reported in the Smithsonian Strandings Database. Blank cells indicate no recorded strandings. If a state or province is missing in the table, no strandings were reported for that area. Abbreviations for states and provinces are explained in Fig. 2.

| State | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Canada** | | | | | | | | | | | | |
| QU | | | | | | | | 1 | 2 | | | |
| PEI | | | | | | | | | 3 | | 3 | 2 |
| **Total** | | | | | | | | 1 | 5 | | 3 | 2 |
| **US** | | | | | | | | | | | | |
| ME | | 1 | 1 | 1 | 1 | | 1 | 4 | 52 | | | |
| NH | 1 | | | 1 | | 1 | 1 | 1 | 1 | | | |
| MA | 19 | 23 | 34 | 26 | 25 | 3 | 9 | 12 | 6 | 4 | 17 | 27 |
| RI | | | | | 1 | | | | | | | |
| CT | | | | | 1 | | | | | | | |
| NY | 1 | | 1 | | 3 | 1 | | 1 | | | | 1 |
| NJ | | | | 2 | | | | | | | | |
| VA | | 1 | | 2 | 2 | | | | | | | |
| NC | | | | 1 | | | | | | | | |
| **Total** | 21 | 25 | 36 | 33 | 33 | 5 | 11 | 18 | 59 | 4 | 17 | 28 |

No studies have tested this proposed population structure, although some samples are available to initiate a genetics study (about 20 specimens). The separation between the Gulf of St Lawrence and the Labrador Sea populations is proposed on the basis of a hiatus of sightings between these two regions (Gaskin, 1992). Evidence for separation between the Gulf of St Lawrence and the southern Gulf of Maine populations is based on a hiatus of summer sightings along the Atlantic side of Nova Scotia, as reported in Gaskin (1992), on the distribution of Smithsonian stranding records, and on a hiatus of sightings recorded during an abundance survey conducted in summer 1995 that covered waters from Virginia to the entrance of the Gulf of St Lawrence (Fig. 2).

## ABUNDANCE

Total abundance of white-sided dolphins in the western North Atlantic is unknown, although four estimates exist from selected regions. Between 1978 and 1982, aerial line-transect surveys were conducted over continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CeTAP, 1982). The abundance estimate based on an inverse variance weighted pooling of spring, summer and autumn data from these surveys was 28,600 (CV = 21%). An average of these three seasons was chosen because the greatest proportion of the population was in the study area during these seasons. This estimate was not corrected for $g(0)$, the probability of detecting an animal group on the trackline. During August 1991 and 1992, two-team shipboard line transect surveys were conducted in the northern Gulf of Maine, lower Bay of Fundy and western Scotia slope region, only a portion of the known summer habitat (Palka, 1995). A weighted-average abundance estimate for this region was 20,400 (CV = 63%), where each annual estimate was weighted by the inverse of its variance (Blaylock *et al.*, 1995). These estimates included a correction for group-size bias and an estimate of $g(0)$, which for each team was, on average, 0.34 (CV = 49%). During June and July 1993, a single-team shipboard survey was conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf (Blaylock *et al.*, 1995). The abundance estimate for this region was 730 (CV = 47%). Group-size bias was considered, but $g(0)$ was not included in this estimate. Finally, from July to September 1995, a sighting survey was conducted from Norfolk, Virginia to the mouth of the Gulf of St Lawrence using two ships and an airplane. White-sided dolphins were seen from the northern edge of Georges Bank, throughout the Gulf of Maine, then east to the southern point of Nova Scotia (Fig. 2). There were also sightings south of Cape Breton to the mouth of the Gulf of St Lawrence. Using sightings west of Nova Scotia the abundance estimate for this area was 27,200 (CV = 43%), which includes an estimate of $g(0)$ (Waring *et al.*, In press). The 1995 survey covered more of the summer white-sided dolphin habitat than any other summer survey. In places where these four surveys overlapped, the relative distribution and abundance patterns were similar. Due to differences in survey methodology it is not possible to determine temporal trends.

## LIFE HISTORY PARAMETERS

Little is known about the life history of white-sided dolphins from the northwest Atlantic. Almost all information comes from an analysis of 65 dolphins stranded in New England between 1973 and 1978 (Sergeant *et al.*, 1980). The majority (53) of these specimens were obtained from two mass stranding events in Maine and Cape Cod. Standard lengths of these animals ranged from 126 to 267cm and body mass ranged from 24 to 234kg. Adult males appeared to be larger than adult females, although no analysis of dimorphism was conducted. Adult females and their offspring dominated the composition of both strandings, although a small number of adult males were present in both strandings. Ages were estimated by counting growth layers in the dentine; the estimated maximum age of males was 22 and that of females was 27. Some growth layers may have been missed in older specimens, resulting in negatively biased estimates of age. The smallest sexually mature female in the sample examined by Sergeant *et al.* (1980) was 201cm. The youngest sexually mature female was approximately six years of age. On the basis of testis mass, males appeared to reach sexual maturity between 220 and 240cm in length. Maximum single testis mass was 370g. A 196cm male dolphin killed in a gillnet in the Bay of Fundy in August 1989 was immature based on testis size (A.J. Read, unpubl. data). The testes of four sexually mature males (255 to 259cm in length) stranded in Wellfleet, Massachusetts in late December 1994 ranged from 94 to 200g and were flaccid, suggesting the existence of a seasonal cycle of variation in testis mass. Pregnant females in the mass stranding on Cape Cod carried foetuses that ranged from 83.5 to 114cm in length (Sergeant *et al.*, 1980). A single pregnant female stranded in Wellfleet, Massachusetts in late December 1994 carried a 47cm foetus (A.J. Read, unpubl. data). Foetal growth is fairly synchronous and Sergeant *et al.* (1980) predicted that most births occur during the summer with a peak in June and July. No quantitative estimation of the duration of gestation has been made. Most mature females were either pregnant or lactating, suggesting a calving interval of approximately two years. Among the mature females in the mass stranding in Maine, 47% were infected with the nematode *Crassicauda grampicola* in the mammary glands. Geraci *et al.* (1978) suggested that the relatively high incidence and severity of lesions resulting from this parasitism could negatively affect reproductive performance of the white-sided dolphin population.

## FOOD HABITS

From scattered observations in the literature it appears that white-sided dolphins feed primarily on small, pelagic schooling fish and squid. Sergeant *et al.* (1980) reported that the prey of animals stranded in Maine included short-finned squid (*Illex illecebrosus*), smelt (*Osmerus mordax*) and silver hake (*Merluccius bilinearis*). Only three additional records of the food of white-sided dolphins from the Northwest Atlantic exist in the literature. Sergeant and Fisher (1957) examined the stomach contents of a 180cm male dolphin driven ashore with pilot whales in Newfoundland on 30 July 1954. The stomach contained the remains of short-finned squid and herring (*Clupea harengus*). Katona *et al.* (1978) made a detailed examination of the stomach contents of a dolphin that had died in a gillnet on 20 July 1976 off the coast of New Hampshire. The stomach of this animal contained four herring (25 to 30cm in length), one partially digested short-finned squid, the remains of 10 other squid and otoliths from 11 silver hake, ranging from 22 to 26cm in fork length. Finally, Schevill (1956) harpooned a 225cm dolphin off Monomoy, Cape Cod in September 1954. This dolphin had been feeding on herring approximately 30cm in length. The stomach also contained two unidentified squid beaks. The stomachs of five white-sided dolphins that stranded in Wellfleet, Massachusetts in late December 1994 contained no identifiable remains. The forestomach of a sixth animal contained several dozen otoliths, which are currently being identified by J.E. Craddock of the Woods Hole Oceanographic Institution (A.J. Read, unpubl. data).

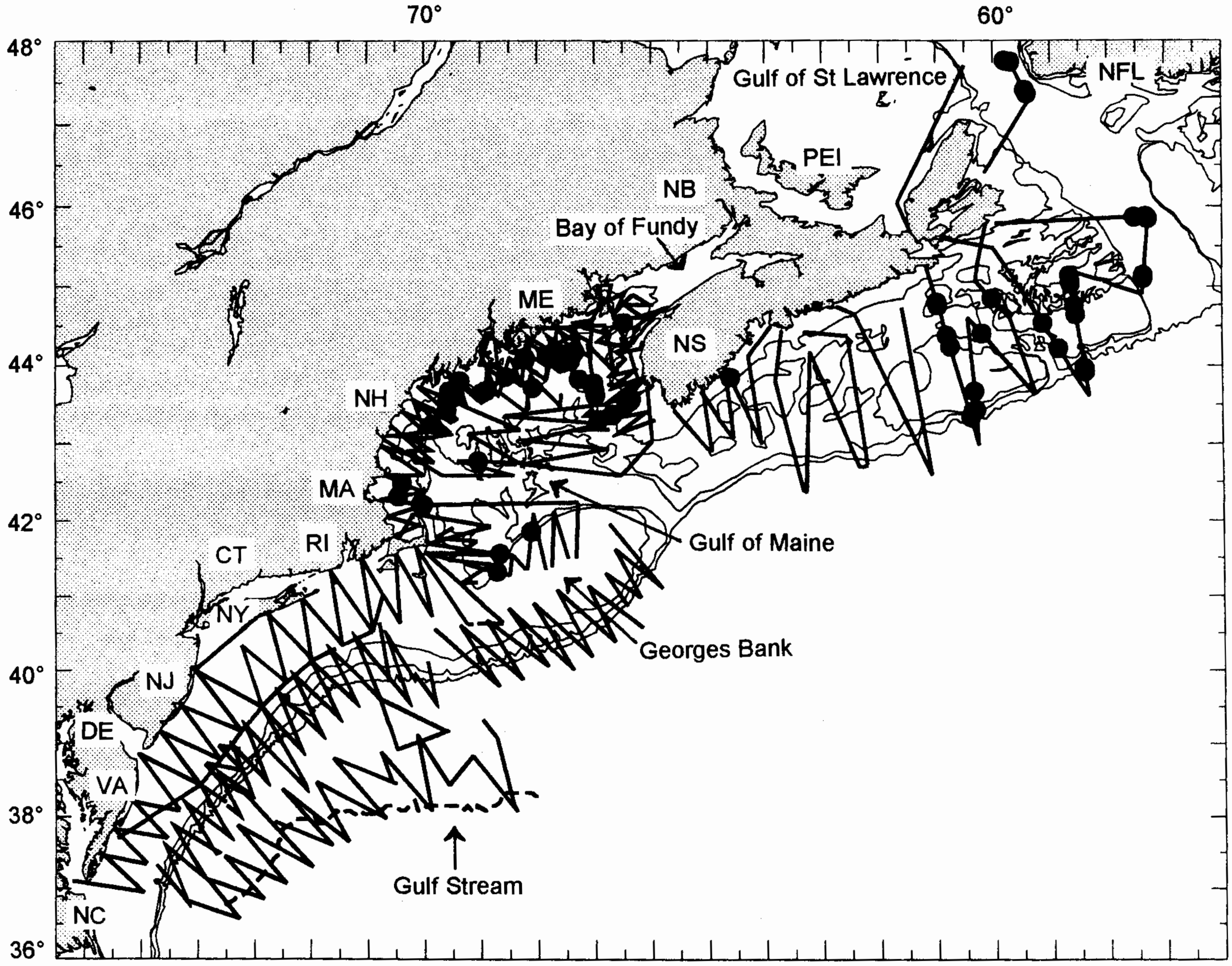


Fig. 2. Location of white-sided dolphin sightings and tracklines covered between 08 July and 18 September 1995 in a dedicated marine mammal line-transect sighting survey conducted by two ships and an airplane. Contour lines are the 50, 100 and 500 fathom depth contours (91, 183 and 914m). Dashed line indicates location of the northern wall of the Gulf Stream at the time of the survey. Abbreviations for Canadian provinces are NB = New Brunswick; NS = Nova Scotia; QU = Quebec; PEI = Prince Edward Island; and NFL = Newfoundland. Abbreviations for US states are ME = Maine; NH = New Hampshire; MA = Massachusetts; RI = Rhode Island; CT = Connecticut; NY = New York; NJ = New Jersey; DE = Delaware; VA = Virginia; and NC = North Carolina.

## BYCATCH

White-sided dolphins have been caught in US groundfish gillnets, pelagic drift gillnets, groundfish bottom trawls and off-bottom trawls. In the Gulf of Maine groundfish gillnet fishery, white-sided dolphins have been taken for over a decade (Gilbert and Wynne, 1987; Blaylock *et al.*, 1995; Waring *et al.*, In press). Between 1990 and 1995, 33 white-sided dolphins were observed taken in this fishery. During this period the average annual bycatch estimate was 121 dolphins (CV = 24%), with annual estimates of 49 in 1991 (CV = 46%), 154 in 1992 (CV = 35%), 205 in 1993 (CV = 31%), 240 (CV = 51%) in 1994 and 80 (CV = 116%) in 1995. In winter months (October to March) most bycatch occurred south of New Hampshire, while in the other months bycatch was dispersed from New York to Maine.

Between 1991 and 1995, an annual average of one white-sided dolphin (CV = 22%) was caught in pelagic drift gillnets along the southern edge of Georges Bank in the summer and off North Carolina in the winter. Annual estimates were 1 in 1991 (CV = 71%), 1 in 1992 (CV = 71%), 3 in 1993 (CV = 17%) and 0 in 1994 and 1995 (Waring *et al.*, In press).

White-sided dolphins have also been taken in the New England groundfish multispecies trawl fishery, which is active all year round. The average annual estimated bycatch from 1991 to 1995 was 58 animals per year (CV = 57%). Annual estimates were 110 for 1992 (CV = 97%), 182 for 1994 (CV = 71%) and zero for 1991, 1993 and 1995.

Forty-two dolphins were observed killed in the Atlantic foreign and joint-venture mackerel off-bottom trawl fishery. This fishery was active between March 1977 and December 1991 on the continental shelf and slope waters (Waring *et al.*, 1990; NMFS unpubl. data). Estimates of total mortality for this fishery are not available. During 1990 and 1992, one white-sided dolphin per year was reported in logbooks from the US off-bottom trawl mackerel and squid fishery, which operates from New Brunswick, Canada to Cape Hatteras.

There is little information on interactions involving white-sided dolphins and Canadian fisheries. Two white-sided dolphins were reported caught in groundfish gillnets in the Bay of Fundy between 1985 and 1989 (Gaskin, 1992). Nine were observed taken in salmon driftnets in the Labrador Sea from 1965 to 1982 (Read, 1994). Several (number not specified) were also taken in Labrador groundfish gillnets in the 1960s (Gaskin, 1992). More recent information on white-sided dolphin takes in Canadian waters is not available.

## METHODS TO REDUCE BYCATCH

White-sided dolphins are not listed as threatened or endangered under the US Endangered Species Act, nor are they included in a list of threatened or endangered species in Canada. In 1995 they were classified by the US as a 'strategic' stock because the average annual human-related mortality exceeded the Potential Biological Removal, or PBR (Blaylock *et al.*, 1995). PBR is the product of the minimum population size (19,196), one-half the maximum productivity rate (0.4), and a 'recovery' factor for endangered, depleted, threatened stocks or stocks of unknown status relative to optimum sustainable population (0.5). This assessment was based on a population estimate covering only a portion of the summer habitat. Using the 1995 abundance estimate which covers a larger portion of the summer habitat, the white-sided dolphin abundance estimate increased and consequentially the species was re-classified as 'non-strategic' (Waring *et al.*, In press). The current PBR level is 192 (CV = 43%) and the average annual US fishery-related mortality for 1990 to 1995 is 181 white-sided dolphins (CV = 25%).

In the US, when a species is classified as 'strategic', a Take Reduction Team is mandated by the Marine Mammal Protection Act (MMPA) to convene to recommend ways to reduce the bycatch level to below PBR. No Take Reduction Team has been created to specifically reduce bycatch of white-sided dolphins. However, a Take Reduction Team has been formed to address bycatch of harbour porpoises in the groundfish sink gillnet fishery in the Gulf of Maine, which takes 67% of the annual US white-sided dolphin bycatch. Therefore, the plan formulated by this Team may also influence the bycatch of white-sided dolphins.

In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species, including white-sided dolphins. Scientific study, and in some cases scientific sampling, is permitted, but only under specific licenses. These regulations, however, have no provisions to regulate bycatches in commercial fisheries. Thus, no specific measures are being taken to reduce bycatch of white-sided dolphins in Canadian fisheries. However, bycatch reduction measures to reduce bycatch of harbour porpoises have been implemented in the Bay of Fundy sink gillnet fishery, which also takes white-sided dolphins. Therefore, these measures may also influence the bycatch of white-sided dolphins in this area.

Methods employed in US waters to reduce bycatch of harbour porpoises include a combination of acoustic alarms or 'pingers' on gillnets and closing areas to fishing during times when it is expected harbour porpoises will be taken in that area. It is not known how acoustic alarms affect white-sided dolphins. Several US time-area closures are instituted during times in areas where white-sided dolphins are present. Thus, it is possible that these measures may reduce bycatch of white-sided dolphins.

In the lower Bay of Fundy, acoustic alarms are used by Canadian fishermen to reduce bycatch of harbour porpoises in the summer groundfish sink gillnet fishery. In addition, this area is closed to gillnets for parts of the summer and fall for groundfish conservation. So, as in US waters, these measures may also reduce bycatch of white-sided dolphins in Canadian fisheries.

## OTHER ANTHROPOGENIC INFLUENCES

Polychlorinated biphenyls (PCBs) and DDT have been found in moderate levels in the blubber of white-sided dolphins from the Bay of Fundy. However, the effect of the observed levels of pollutants is unknown (Gaskin, 1985).

Kuehl *et al.* (1991) compared residue concentrations for three incidentally taken white-sided dolphins (2 males and 1 female) and four incidentally taken common dolphins (*Delphinis delphis*) with residue concentrations of 14 bottlenose dolphins (*Tursiops truncatus*) that died during and subsequent to the mass mortality of 1987/88 along the US Atlantic coast. Concentrations of pesticides, polychlorinated biphenyls (PCBs), dibenzo-p-dioxins (PCDDs) and dibenzogunans (PCDFs) were determined for various tissues from each of these specimens. In general, these contaminant concentrations were higher in the bottlenose dolphins than in either white-sided or common dolphins. Although, the white-sided dolphins had the highest concentration of trans-nonachlor and dieldrin.

In 1994, Kuehl *et al.* (1994) reported on the coplanar PCBs and metal residues in animals from their 1991 paper. In addition, toxic equivalent concentrations (TECs) for coplanar PCB, 2.3.7.8-tetrachlorodibenzo-p-dioxin (TCDD) were calculated for various PCB congeners. In the white-sided dolphins, metal residues of mercury, selenium, chromium, manganese, lead and cadmium were present. The metal residues for all the elements except for chromium were lower or in the same range in the white-sided dolphins as in the common and bottlenose dolphins. The chromium concentrations in the adult male white-sided dolphin were roughly twice that of the adult male and female common and bottlenose dolphins and six times that of an immature female bottlenose dolphin. Unfortunately limited sampling, sampling bias, as well as other factors (see IWC, 1997) limit conclusions that may be drawn from these data.

Mass strandings, involving up to a hundred or more animals, are not uncommon for this species. The cause(s) of these strandings are not known. Because such strandings have occurred since antiquity, it is presumed that they are a normal condition (Gaskin, 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. Strandings data underestimate the extent of fishery-related mortality because not all marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interactions.

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## REFERENCES

Blaylock, R.A., Hain, J.W., Hansen, L., Palka, D.L. and Waring, G.T. 1995. US Atlantic and Gulf of Mexico marine mammal stock assessments. *NOAA Tech. Mem.* SEFSC-363:211pp.

CeTAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the US outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48. Bureau of Land Management, Washington, DC. 538pp.

Evans, P.G.H. 1987. *The Natural History of Whales and Dolphins.* Christopher Helm, London. xvi+343pp.

Gaskin, D.E. 1985. *The Ecology of Whales and Dolphins.* Heinemann Educational Books, London. 459pp.

Gaskin, D.E. 1992. Status of the Atlantic white-sided dolphin (*Lagenorhynchus acutus*) in Canada. *Can. Field-Nat.* 106(1):64-72.

Geraci, J.R., Dailey, M.D. and St. Aubin, D.J. 1978. Parasitic mastitis in the Atlantic white-sided dolphin, *Lagenorhynchus acutus*, as a probable factor in herd productivity. *J. Fish. Res. Board Can.* 35:1350-5.

Gilbert, J.R. and Wynne, K.M. 1987. Marine mammal interactions with New England gillnet fisheries. Final report, contract No. NA-84-EAC-00070 to the Northeast Fisheries Science Center, US National Marine Fisheries Service (unpublished). 20pp.

International Whaling Commission. 1997. Report of the sub-committee on small cetaceans. (Published in this volume).

Katona, S.K., Testaverde, S.A. and Barr, B. 1978. Observations on a white-sided dolphin, *Lagenorhynchus acutus*, probably killed in gill nets in the Gulf of Maine. *Fish. Bull., US* 76:475-6.

Katona, S.K., Rough, V. and Richardson, D.T. 1993. *A Field Guide to Whales, Porpoises and Seals from Cape Cod to Newfoundland.* Smithsonian Institution Press, Washington, DC. 316pp.

Kenney, R.D., Payne, P.M., Heinemann, D.W. and Winn, H.E. 1996. Shifts in Northeast shelf cetacean distributions relative to trends in Gulf of Maine/Georges Bank finfish abundance. pp. 169-96. *In:* K. Sherman, N.A. Jaworski and T. Smada (eds.) *The Northeast Shelf Ecosystem: Assessment, Sustainability and Management.* Blackwell Science, Cambridge, MA 02142, USA.

Kuehl, D.W., Haebler, R. and Potter, C. 1991. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987-88 mass mortality. *Chemosphere* 22(11):1071-84.

Kuehl, D.W., Haebler, R. and Potter, C. 1994. Coplanar PCB and metal residues in dolphins from the United States Atlantic coast including Atlantic bottlenose obtained during the 1987/88 mass mortality. *Chemosphere* 28(6):1245-53.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. *Rep. int. Whal. Commn* (special issue 16):27-50.

Payne, M. and Heinemann, D.W. 1990. A distributional assessment of shelf and shelf edge waters of the northeastern United States based on aerial and shipboard surveys, 1978-1988. Report to National Marine Fisheries Science Center, Woods Hole, MA 02543, USA.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. *Rep. int. Whal. Commn* (special issue 15):133-48.

Schevill, W.E. 1956. *Lagenorhynchus acutus* off Cape Cod. *J. Mammal.* 37:128-9.

Sergeant, D.E. and Fisher, H.D. 1957. The smaller Cetacea of eastern Canadian waters. *J. Fish. Res. Board Can.* 14(1):83-115.

Sergeant, D.E., St. Aubin, D.J. and Geraci, J.R. 1980. Life history and northwest Atlantic status of the Atlantic white-sided dolphin, *Lagenorhyncus acutus*. *Cetology* 37:1-12.

Stenson, G.B. and Reddin, D.G. 1994. Incidental catches of small cetaceans in drift nets during salmon tagging experiments in the northwest Atlantic [Abstract]. *Rep. int. Whal. Commn* (special issue 15):628.

Waring, G.T., Gerrior, P., Payne, P.M., Parry, B.L. and Nicolas, J.R. 1990. Incidental take of marine mammals in foreign fishery activities off the Northeast United States, 1977-1988. *Fish. Bull., US* 88:347-60.

Waring, G.T., Palka, D.P., Hain, J.W., Hansen, L.J., Blaylock, R.A. and Bisack, K.D. In press. US Atlantic and Gulf of Mexico marine mammal stock assessments. *NOAA Tech. Mem.*